66th International Astronautical Congress 2015

45th STUDENT CONFERENCE (E2)
Educational Pico and Nano Satellites (4)

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DESIGN AND DEVELOPMENT OF SEPARATION MECHANISM FOR TWIN NANO SATELLITE - STUDSAT-2

Abstract

This paper describes the design and development of Separation Mechanism for Twin Nano- satellite named "STUDSAT-2". STUDSAT (STUDent SATellite) project is undertaken by a group of students pursuing undergraduate course from INDIA. The mission is to demonstrate inter-satellite communication between two nano satellites STUDSAT-2A and STUDSAT-2B in low earth orbit. The satellite is presumed to be launched in the Polar Satellite Launch Vehicle (PSLV) a four-stage launch vehicle controlled and maintained by the Indian Space research Organisation (ISRO). Nano-satellites are designed for the dimension 300mmx300mmx150mm with mass 5 kg and 4.5 kg each. The separation mechanism is interfaced between two nano-satellites (STUDSAT 2A and STUDSAT 2B). After the ejection from the rocket, the satellites remain attached for an estimated period of 3 orbits before separation. Developing a reliable separation mechanism supporting launch vehicle and the space constraints is of the highest importance. The main objective of this work is to design a separation mechanism in order to achieve in-orbit inter satellite separation of 100 km in 100 days, considering the limitations of the communication module to prove inter satellite communication. The analytical calculation required to achieve the relative velocity is performed. Various design approaches have been considered to reduce the surface contact at the time of separation so as to reduce the orbit shift during separation. Static structural and dynamic analysis has been conducted using ANSYS finite element analysis tool to validate the design. The major design challenge in the mission is to develop a mechanism which maintains its structural integrity during the

vibrations generated due to launch and also during the separation in space . Different alternatives of actuation and clamp design has been considered and a single point separation mechanism satisfying the functional requirements is fabricated. Apart from simulation study on Solid Works simulation analysis, table top test setup has been developed to verify whether the analysis results matches the practical results. The factors taken into consideration in deciding the right choice of mechanism includes cost, weight, insulation, response time, power consumption, mass symmetry and material selection. The reliable separation mechanism can be further extended to nano satellite applications involving formation flying of two satellites or cluster of satellites.